

Comparison of Amniotic Fluid Index at Different Gestational Age in Normal Pregnancy

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Abstract

Sonographic assessment of amniotic fluid has formed an integral and important component of pregnancy assessment of fetal wellbeing. Changes in amniotic fluid volume are associated with variable outcome of the fetus. Amniotic fluid index which is an objective means of assessing adequacy of amniotic fluid volume does not only vary with gestational age but also differs from population to population. The study determined the reference values of amniotic fluid index and compared the values with the established ranges throughout gestation in uncomplicated singleton pregnancies among women attending our antenatal care facility. This was a longitudinal prospective assessment of amniotic fluid index in eighty six healthy pregnant women with singleton pregnancies recruited at 20 to 22 weeks of gestation and followed up to 41 weeks and 3 days. The patients recruited at 20 weeks had amniotic fluid measurements at recruitment and 4 weeks apart until 40 weeks gestation. Those recruited at 22 weeks had it also at recruitment and 4 weekly with the last estimation at 41 weeks +3 days. These measurements were plotted against their respective gestational ages. The graph was then analyzed using statistical and graphical packages of SPSS version 21. The study populations mean, 5th and 95th percentiles was documented and discussed appropriately. A total of 414 readings were obtained from 81 subjects who underwent more than 3 measurements. Analysis of the data obtained shows a rising AFI with a mean 28 weeks and, thereafter gradually fell till term. The mean age obtained in the study group compared with that of Caucasians showed statistically significant difference (P=0.014). Also, comparison with Chama et al. showed obvious statistical difference at the lower limit (5th percentile; P=0.007, 50th percentile; P=0.006) but no differences at the upper limit (95th percentile; P=0.726). Amniotic fluid index values appear to be differing in different population. The reference range of AFI used in clinical practice should therefore be based on data obtained from local population.

Keywords: Amniotic fluid index; Pregnancy; Obstetric care; Ultrasound scan

Introduction

Ultrasound assessment of amniotic fluid has significant implication in obstetric care and it has become an integral and important component of pregnancy assessment [1,2]. Its evaluation is vital for predicting fetal well-being as abnormalities of amniotic fluid are often associated with fetal mortality, morbidity and anomaly [3,4].

The importance of the amniotic fluid volume as an indicator of fetal well-being has been extensively documented [5-11]. It reflects both mother and fetal status [12]. The maintenance of appropriate amniotic fluid volume for gestational age remains an important and integral component for fetal well-being determination [13].

It is therefore necessary that the normal values of the amniotic fluid across the gestational age be established [1].

A number of methods of amniotic fluid assessment have been evaluated; this ultrasonic evaluation of the amount of amniotic fluid remains the preferred approach to amniotic fluid estimation in clinical practice simply because it is widely available and is non-invasive [14-19].

It can be either a subjective assessment (visualization without ultrasonic measurements), a semi quantitative estimation using the single deepest pocket otherwise equivalent to maximum vertical pocket depth, amniotic fluid index [14,20,21] 2 diameter pocket [22] or 3 dimensional measurements [23].

Of the three methods, the amniotic fluid index, developed by Phelan and colleagues, which better reflects the intrauterine content, seems to be more advantageous than the measurement of the single deepest amniotic fluid pouch, and has been recommended as the optimum approach with reliable validity [24,25].

The technical bulletin on obstetric ultrasonography from The American College of Obstetrician and Gynecology states that amniotic fluid index is a more accurate and reproducible method of determining abnormalities in amniotic fluid volume than are other techniques [26].

Amniotic fluid index is reported to vary not only with gestation [12] but also with population [3]. Several studies on amniotic fluid index have demonstrated serial changes in mean AFI values weekly with threshold for oligohydramnios and polyhydramnios during pregnancy [3,26-28].

However, as AFI values may be affected by the difference of race and environment, caution is exercised when previously established AFI values are applied to pregnant women with different racial and environmental backgrounds [1].

Thus, evaluation of normal values in different population may be considered necessary. To date, it appears that only four studies [2,29,30] have been reported to establish normal values of amniotic fluid volume in Nigeria to the best of the researcher's knowledge.

This study was designed to determine normal values of amniotic fluid volumes for single uncomplicated pregnancies in our center.

Materials and Methods

This was a comparative longitudinal prospective assessment of amniotic fluid index in healthy pregnant women with singleton pregnancies.

Included were all pregnant women who had given consent and with; singleton cephalic presenting pregnancy, reliable dating of gestational age (regular menstrual cycle, certain first day of the last normal menstrual period and no form of contraception in the last 6 months of conception), confirmed last menstrual period by ultrasound scan done before 20 weeks of gestation and dating in agreement to within 7 days. Subjects who did not meet above inclusion criteria or decline consent to participate were excluded.

Also, those with recognized maternal or fetal morbidities such as; diabetes, hypertension (BP \geq 140/90 mmHg), significant proteinuria ($>$ 1+ on urine dipstick), sickle cell disease, history of antepartum hemorrhage, poor obstetrics history, or prior ultrasound features suggesting suspected intra-uterine growth restriction, IUFD and any known fetal abnormality.

Enrolled subjects were recruited and allocated into two groups. This was for the purpose of obtaining a reading every two weeks even though patients were being seen every 4 weeks.

It also minimized loss to follow up and maximized the observations. One group of subjects had examinations at 20, 24, 28, 32, 36 and 40 weeks. The other group was examined at 22, 26, 30, 34, 38 and 41 weeks 3 days.

All these assessments were at no extra cost to the patient. The sample size was calculated using the formula for estimating populations' mean [31].

$$\text{Sample size, } N = Z^2 \delta^2 / \epsilon^2$$

$$N = \text{Sample size}$$

Z= is the abscissa of the normal curve that cuts off an area α at the tails (1.96)

δ =population standard deviation or variance (3.89 for 20 weeks while 3.06 for 22 weeks) [29]

ϵ =error range obtained from pilot study (11%)

For mothers at 20 weeks:

$$N = (1.96)^2 (3.89)^2 / (1.1)^2 = 48$$

Adding 10% attrition rate to the value obtained above, 53 women were recruited at 20 weeks.

For mothers at 22 weeks:

$$N = (1.96)^2 (3.06)^2 / (1.1)^2 = 29$$

Adding 10% attrition rate to the value obtained above, 33 women were recruited at 22 weeks.

Total sample size for the study was 86 pregnant women.

Statistical Analysis

- Data were analyzed using Statistical Package for Social Science (SPSS version 21).
- P-value of less than 0.05 was accepted as indicating statistical significance.

Results

A total of 5 women were excluded out of the 86 recruited for the study due to development of antenatal complications capable of interfering with Amniotic fluid volume.

While 2 each developed Hypertensive disease in pregnancy and Diabetic mellitus in pregnancy, 1 had spontaneous miscarriage.

Thus, a total number of 414 readings were obtained from the 81 patients who underwent more than three examinations.

The age range of the study subjects was 15 to 44 years with a mean age of 28 years. The participants ranged from those that were Para zero to Six.

The data were normally distributed at each gestation. The study showed AFI rising from 20 weeks to 28 weeks and thereafter, demonstrated steady but gradual decline as pregnancy advances.

Table 1 describes the descriptive data for AFI. The results were stratified by week of gestation.

The 5th, 50th and 95th percentiles ranged from 6.58, 14.50 and 18.54 respectively, at 20 weeks to 5.44, 8.15 and 9.01 respectively, at 41 weeks 3 days.

It is interesting to note that all the values were within 8 to 25 cm range (which is accepted and established normal range for AFI values worldwide).

GA ^a (weeks)	Mean (cm)	5 th centile (cm)	50 th centile (cm)	95 th centile (cm)
20	13.82	6.58	14.5	18.54
22	16.59	14.08	16.3	19.88
24	17.4	14.71	17.45	19.43
26	18.19	16.35	18.2	20
28	18.73	15.7	19.3	22.05
30	15.03	12.42	14.95	17.68
32	14.25	10.42	15.2	17.1
34	12.46	8.82	12.3	15.08
36	8.75	7.3	9.2	12.46
38	8.57	6.93	8.45	11.65
40	8.38	6.79	8.25	10.11
41 ^x	8.2	5.44	8.15	9.01

Table 1: Descriptive representation of AFI [GA^a: gestational age, 41^x: 41 weeks and 3 days].

The maximum value of AFI in any single patient was 18.73 cm and minimum 8.2 cm in the series of low risk antenatal pregnant women

studied. If 5th centile (minimum) and 95th centile (maximum) are considered as normal range, it was noted that the corresponding values too were different at different gestational age.

Comparison of the mean age obtained in the study group with that of Caucasians shows statistically significant difference (P=0.014).

Also, comparison with Chama et al. shows obvious statistical difference at the lower limit (5th percentile; P=0.007, mean; P<0.001) but no differences at the upper limit (95th percentile; P=0.726) (Tables 2-5).

GA ^a (weeks)	50 th centile (cm)	Caucasian values (cm)
20	14.5	14.3
22	16.3	16
24	17.45	17.3
26	18.2	18.2
28	19.3	18.7
30	14.95	19
32	15.2	18.8
34	12.3	18.2
36	9.2	17.3
38	8.45	16.1
40	8.25	14.5
	P-value=0.014	

Table 2: Comparative values of AFI with those of Caucasian (GA^a: gestational age) [26].

GA ^a (weeks)	5 th centile (cm)	Chama 5 th percentile (cm)
20	6.35	14.4
22	14.08	16.4
24	14.71	18.72
26	16.35	18.3
28	15.7	16.6
30	12.42	15.25
32	10.42	14
34	8.82	11.4
36	7.3	11.3
38	6.93	8.25
40	6.79	4.8
	P-value=0.007	

Table 3: Comparative values of 5th percentile AFI in the study group with 5th percentile of Chama.

GA ^a (weeks)	Mean AFI (cm)	Chama mean (cm)
20	13.82	17.18
22	16.59	18.54
24	17.4	20.22
26	18.19	20.39
28	18.73	19.59
30	15.03	17.65
32	16.25	16.72
34	12.46	14.61
36	8.75	13.83
38	6.57	9.71
40	6.23	8.82
	P-value<0.001	

Table 4: Comparative values of mean AFI in the study group with mean of Chama.

GA ^a (wks)	95 th centile (cm)	Chama 95 th percentile (cm)
20	18.54	20.5
22	19.88	20.1
24	19.43	21.7
26	20	23.4
28	22.05	23.2
30	17.68	19.87
32	17.1	18.8
34	15.08	16.7
36	12.46	16.8
38	11.65	10.8
40	10.11	12.6
	P-value=0.726	

Table 5: Comparative values of 95th percentile AFI in the study group with that of Chama.

Discussion

Amniotic fluid production and regulation is a complex and dynamic process involving fetus, placenta and mother. Amniotic fluid volume gradually increases till 32-34 weeks of gestation and thereafter there is a gradual reduction till term [12,26]. The critical AFI range of 8 to 25 cm signifies fetal well-being and the variation from this range is associated with increase in fetal and maternal complications due to oligohydramnios and polyhydramnios. AFI values most especially in third trimester are proportionate to the fetal urine production, nutrients and oxygen transfer [23]. Hence, monitoring the AFI has become a standard of antenatal care [32,33].

In this study, the gestation specific percentage values of amniotic fluid index have been formulated for the uncomplicated pregnant Abuja women. While various studies [29,34] recorded their peak AFI values at 26th week of gestation, the peak mean AFI value in the present study was recorded at the 28th week of gestation. Igbinidu and colleagues reported similar findings [2]. Salahuddin et al. observed peak AFI values amongst Japanese women at 30 weeks gestation [34], Birang arrived at a peak mean AFI value at 27 weeks gestation in an Iranian population. The difference in these findings may be due to racial and environmental factors [35,36], a reason which is buttressed by the fact that previous studies carried out in the southern Nigeria and northern Nigeria were at variance. Also, the transient drop in the AFI values reported by few studies [2,30] from Nigeria were not observed in this study. This observation is similar to virtually all other studies.

The results of this study compared with 14.3 cm-19 cm at 20-30 weeks and 18.8 cm-14.5 cm at 32 weeks-40 weeks for Caucasian population by Nwosu et al. [26], are significantly different ($P=0.014$). The lowest (5th centile) and median (50th centiles) values of AFI from this study also differ statistically from those of Chama however, not statistically different from values obtained at upper limits ($P=0.726$), most probably due to the reason stated above.

Also, a wide variation of "normal" AFI values within the same gestational week throughout pregnancy was observed. A feature that is common to most studies of amniotic fluid index. This finding is not surprising though, as Brace and Wolf [12] had documented a wide variation in amniotic fluid volume at each gestational week in their study.

This study has determined the curves of normal amniotic fluid values for each gestational age and defined lower and upper limits of normal. The values obtained from this study therefore can serve as a preliminary for quantitatively assessing AFV across this locality. However, it is important to recognize that due to small sample size a larger multicenter studies are needed for proving more accurate estimates of normal range in Nigerian population.

Conclusion

Therefore, it appears that due to racial and climatic factors, AFI differs from population to population. The reference range of AFI used in clinical practice should therefore be based on data obtained from local population. The values obtained in this study may assist the Obstetrician in this environment in adequately assessing amniotic fluid volume in pregnancy and improving fetomaternal care, thus reducing perinatal morbidity and mortality.

Ethical Consideration

The ethical clearance for this study was sought and obtained from the Research and Ethics Committee of the University of Abuja Teaching Hospital. Clients' anonymity was maintained.

Clients were only identified by code numbers. No client was denied of any form of services upon refusal of consent nor any client promised facilitation of services to coerce them into giving consent.

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